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DECOMMISSIONING OF URANIUM MINES AND MILLS - CANADIAN REGULATORY APPROACH AND EXPERIENCE

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ABSTRACT

At the time of the recent closures of the Agnew Lake, Beaverlodge and Madawaska Mines Limited uranium mining and milling facilities, several relevant regulatory initiatives, including the development of decommissioning criteria, were underway, or contemplated. In the absence of precedents, the regulatory agencies and companies involved adopted approaches to the decommissioning of these facilities that reflected site specific circumstances, federal and provincial regulatory requirements, and generally accepted principles of good engineering practice and environmental protection. This paper summarizes related historical and current regulatory policies, requirements and guidelines; including those implemented at the three decommissioned sites.

RÉSUMÉ

Au moment des fermetures récentes des installations d'extraction minière et de concentration d'uranium d'Agnew Lake, de Beaverlodge et de Madawaska, plusieurs mesures réglementaires pertinentes, dont l'établissement de critères pour le déclassement, étaient envisagées ou à l'étape de l'élaboration. En l'absence de précédent, les organismes de réglementation et les sociétés en cause ont adopté des méthodes de déclassement pour ces installations, qui tenaient compte des circonstances particulières à chaque site, des exigences réglementaires provinciales et fédérales, et des principes reconnus sur les bonnes pratiques d'ingénierie et de protection de l'environnement. Le présent document résume les politiques, exigences et lignes directrices anciennes et actuelles, y compris celles qui s'appliquent aux trois sites déclassés.

DECOMMISSIONING OF URANIUM MINES AND MILLS - CANADIAN REGULATORY APPROACH AND EXPERIENCE

1. BACKGROUND

A proper appreciation of current regulatory concerns and initiatives relating to the potential long-term effects of uranium mill tailings requires an understanding of related historical developments.

Prior to the early 1960's, uranium tailings management practices in Canada and elsewhere were primarily determined by operational requirements. Chief amongst these were water balance considerations and the desire to dispose or contain the large volume of tailings generated as conveniently and economically as possible. In Canada, the latter requirements were most easily satisfied by the use of nearby lakes or natural depressions for tailings deposition. Natural topographical features were often improved upon for purposes of tailings confinement by construction of retention dams or berms. These structures were generally built with locally available materials, most commonly waste rock from the mining operations. Their generally permeable nature permitted relatively significant seepage losses. The severe recession in the uranium mining industry in the 1960s led to the closure of most Canadian mines and mills. These shut down without any consideration, or implementation, of special decommissioning or reclamation measures for uranium mill tailings. Those decommissioning activities completed coincident with, or subsequent to, shut-down were implemented voluntarily, primarily for practical or economic considerations. The potentially adverse effects of abandoned uranium tailings on the environment were largely undocumented at that time. However subsequent studies and observations, particularly those related to pyritic uranium tailings, identified specific instances of environmental degradation and implied the existence of others. Public concern over the potentially adverse environmental effects of uranium mining activities increased, reflecting in part an escalating public awareness of environmental issues in general.

In the early 1960s Tsivoglu and O'Connell of the Robert A. Taft Sanitary Engineering Center in Cleveland, Ohio researched radium-226 levels in the Animas River and subsequently (1962) published a "Waste Guide for the Uranium Milling Industry"(17). Concern in Ontario regarding the increasing concentrations of radium in the Serpent River basin led to establishment of a government committee to assess the problem. The resultant report, issued in 1965, gave impetus to the implementation of such measures as water conservation in uranium mills, barium-chloride treatment of mill effluent to precipitate radium, and environmental monitoring programs. The Canadian operations that survived the economic downturn of the 1960s - early 1970s, or came on-stream later, adopted tailings neutralization, effluent treatment (radium removal, pH adjustment) and improved containment of mill tailings and liquid wastes.

Since the mid-1970s all operating uranium mines and mills have been subjected to extensive government regulation. The latter currently includes public hearings and environmental review processes for proposed operations as well as radiation dose limits, effluent discharge limits for radioactive and non-radioactive parameters, monitoring requirements, and various other conditions of licence or regulation related to health, safety, and protection

of the environment for operating facilities. Regular compliance inspections of all operations are conducted by both federal and provincial agencies. The adoption of effective measures to limit, and audit, the environmental and health and safety effects of uranium mining and milling facilities has over recent years resulted in a general level of industry performance that demonstrates that such activities can proceed safely, and with acceptable impacts during the operational phases. Consequently, regulatory agencies in Canada and elsewhere have become increasingly conscious of the need to extend this assurance to the longer term; that is, the post-operational phase. To that end, various regulatory initiatives are being pursued within Canada. These are reviewed, and described in more detail, in the subsequent section.

2. REGULATORY DEVELOPMENTS

As noted above, regulatory concerns over the adequacy of current tailings management methods relate increasingly to long term effects - the probable nature and significance of those effects. A significant probability that existing tailings may pose unacceptable risks to future populations implies a moral responsibility on the part of current operators and regulators to ensure that appropriate precautions are taken to minimize to the extent practical such potential harm. Consequently, the federal government announced in September, 1982 that it would launch the National Uranium Tailings Program (NUTP), a comprehensive Research and Development program into the long-term effects of uranium mill tailings on the environment. $7.7 million were allocated for a five-year period ending in March, 1987. Under the direction of Energy, Mines and Resources Canada, this phase is nearing completion with the anticipated outcome to include the generation of a probabilistic predictive mathematical model and application of the same to the Lacnor and Rabbit Lake tailings sites.

At a time when the NUTP was conceptual only, staff of the AECB recognized that should the program proceed, it would be unlikely to contribute significant new information on the long term effects of uranium tailings for several years. Further, should any uranium mine and mills close in the interim, regulatory guidance relating to decommissioning of these facilities would be solicited, and required. Consequently, in January, 1981 the AECB circulated for public review and comment Consultative Document C-1, a proposed regulatory guide titled "Long Term Aspects Of Uranium Tailings Management". C-1 proposed <u>interim</u> criteria and guidelines for the decommissioning and post-operational management of uranium mill tailings. Reviewers of C-1 were, in general, supportive of the development of regulatory standards to address the decommissioning or "close-out" of uranium mill tailings and associated waste management systems. However, industry representatives considered several aspects of the document unjustifiably onerous; in particular, proposed numeric criteria for gamma and radon attenuation. Other criticisms advanced included arguments that inadequate allowance had been made for site-specificity, and that more credit should be given for institutional controls. Subsequent to AECB review of the comments received on C-1, the document was supplanted by the issuance July 29, 1983 of draft "Guidelines For The Preparation of Decommissioning Plans for Uranium Mine Waste Management Systems". The stated objectives of these guidelines were "to give the necessary direction to companies preparing their decommissioning plans" and to "provide the AECB and other regulatory agencies with guidelines and criteria for evaluating the

quality of decommissioning activities at a site." The 1983 "Guidelines" can be summarized as follows:

- Reliance on institutional controls as a means of adhering to these guidelines should be minimized;

- Access to tailings or other contaminated waste material should be minimized;

- The dose limits specified in the Atomic Energy Control Regulations shall apply;

- The use of passive barriers, either natural or engineered to contain radioactive and non-radioactive contaminants within a decommissioned site should be maximized;

- Where containment systems may degrade continuously with time, preference should be given to systems which degrade gradually;

- There should be no need for frequent maintenance of containment systems;

- The annual quantities of radioactive and non-radioactive contaminants discharged to the environment after decommissioning and abandonment should not exceed those allowed during the operational phase;

- The concentrations of contaminants released from a decommissioned site should comply with local water quality objectives at designated points.

Since the issuance of the above guidelines, the AECB has released for public review and comment additional Consultative Documents having potential implications for the future decommissioning of uranium mines and mills. These include C-36, "A Guide To The Licensing Of Uranium And Thorium Mine And Mill Waste Management Systems"; C-59, "Regulations Respecting Uranium Mining"; C-83, "Proposed General Amendments To The Atomic Energy Control Regulations"; C-85, "The Basis For Exempting The Disposal of Certain Radioactive Materials From Licensing"; C-90, "Policy On The Decommissioning of Nuclear Facilities"; and C-95, "Policy Statement On Maximum Acceptable Levels Of Contamination On Equipment And Materials Leaving Uranium Mine Facilities".

The potential implications of these various Consultative Documents, in the context of the decommissioning of uranium mines and mills, are summarized in Table 1 attached.

3. DECOMMISSIONING EXPERIENCE

On December 3, 1981, Eldorado Nuclear Limited (currently Eldorado Resources Limited) announced that it would close its Beaverlodge, Saskatchewan operations effective June 30, 1982 and decommission the complex. Within a few months, Madawaska Mines Limited and Agnew Lake Mines Limited followed with similar announcements of the intended closure of their respective uranium processing operations in Ontario. These closure announcements pre-empted efforts by AECB staff to formalize in advance of such occurrences regulatory requirements specific to the decommissioning of uranium mines and mills.

However, AECB Consultative Document C-1 titled "Long Term Aspects of Uranium Tailings Management" which proposed draft "close-out" criteria for uranium mining and milling facilities, was under review. In addition, the AECB had recently received, in response to conditions inserted in Mine Facility Operating Licences, conceptual decommissioning plans for the Beaverlodge[7], Madawaska, and Agnew Lake[2] operations. These prior developments facilitated the subsequent formulation of acceptable decommissioning strategies for the three sites.

The decommissioning and reclamation of the Beaverlodge mine, mill and waste management complex was undertaken in the absence of comparable precedents. Thus, in response to requests by the Company for appropriate regulatory direction and criteria, an approach was developed for the Beaverlodge situation that, in effect, established a degree of precedent for the subsequent decommissioning of the Madawaska and Agnew Lake facilities. At initial discussions amongst Eldorado, AECB, Environment Canada, Labour Canada, Saskatchewan Labour and Saskatchewan Environment agreement was reached that the joint-regulatory licensing process endorsed by AECB would be followed during the decommissioning and reclamation of the Beaverlodge facility. Lead responsibility for coordinating the review of the anticipated submissions, studies and proposals was to be assumed by AECB staff, as was the responsibility of conveying regulatory review comments and decisions to the Company. The decommissioning and reclamation plans for the site were to be developed and implemented under the terms of a licence to be issued by the AECB. The latter was to address not only the requirements of the AECB but the legitimate concerns of the other regulatory agencies as well. Consequently, on September 1, 1982, the AECB issued to Eldorado Nuclear Limited Decommissioning and Close-Out Approval AECB-DCOA-130-0[4]. This licence established the regulatory constraints under which Eldorado would pursue development and implementation of an acceptable decommissioning plan for their Beaverlodge facilities. It contained a number of conditions relating to health, safety, and protection of the environment. Amongst these were several of the requirements and principles enunciated in Consultative Document C-1, including the following:

- The dose limits specified in the AEC Regulations shall be observed;

- Any exposures arising from the site should be kept as low as reasonably achievable, economic and social factors being taken into account;

- The annual quantities of radioactive and non-radioactive contaminants released to the environment should not exceed the corresponding releases during the operational phase;

- Dust emissions from the closed-out site should be minimized in a manner consistent with good engineering practice;

- The use of passive barriers, natural or engineered to control radioactive and non-radioactive releases from the closed-out site should be maximized;

- The use of containment systems which may be subject to abrupt degradation of performance should be minimized and preference given to systems which only degrade gradually.

Several site specific criteria, distinct from those proposed in C-1, were also included in AECB-DCOA-130-0. These reflected both joint and individual interests of the regulatory agencies involved such as:

- Application of provincial Water Quality Objectives at various sampling points;

- Gamma attenuation criteria (requirements and objectives);

- Decontamination criteria for salvaged materials.

In order to develop, support and defend a preferred decommissioning and reclamation plan for the Beaverlodge complex, Eldorado undertook a number of related projects and studies(10) (11) (12) (13) (15) (16). These included identification and quantification of wastes, collection of environmental data, hydrologic investigations, water quality modelling, laboratory studies, engineering feasibility studies, and radiological and environmental assessments of potential options. These activities culminated in August, 1983 with the submission to the regulatory agencies of the Company's proposed plan(8) for close-out of the Beaverlodge site. This proposal was subsequently approved by the regulatory agencies, and Decommissioning and Close-Out Approval AECB-DCOA-130-0 replaced by Decommissioning Approval AECB-DA-142-0(5). The latter approval contained specific references to the approved close-out plan and the monitoring of site performance upon completion of the scheduled decommissioning and reclamation activities. Implementation of the plan was completed in July, 1985. Since that time, the company and regulatory personnel have embarked upon a five-year monitoring program to verify the effectiveness of the completed decommissioning and reclamation activities. Subject to satisfactory performance of the decommissioned facility relative to the predictions advanced in the Eldorado Resources Limited report, "Plan for the Close-Out of the Beaverlodge Site", the province of Saskatchewan has agreed to accept subsequent responsibility for the site. AECB regulatory controls over the site would then be allowed to lapse, and the Company would be absolved of future obligations under the Atomic Energy Control Regulations.

The regulatory approaches adopted for the decommissioning of Madawaska and Agnew Lake paralleled in major respects that applied to the Beaverlodge situation. Similar licensing mechanisms, joint regulatory process and requirements under the Atomic Energy Control Act were instituted. In spite of the consistency in overall objectives and philosophies of approach, the approved decommissioning programs(1),(9), performance standards, and monitoring programs differ in some respects. For the most part, these differences reflect site specific factors such as the nature and complexity of historical and current operations, the physical and climatic environment, and the characteristics of wastes; not to mention the preferences, objectives or requirements introduced by the involvement of various individuals representing different companies or government jurisdictions.

Madawaska Mines Ltd. and Agnew Lake Mines Ltd. are currently decommissioning their former operations under the terms of AECB licences, Decommissioning Approval AECB-DA-139-0(6) and Decommissioning and Close-out Approval AECB-DCOA-132-0,(3) respectively. Like the Decommissioning Approval

issued for Beaverlodge, these licences specify that the completion of decommissioning activities will be followed by monitoring phases to assess their effectiveness. Upon completion of the monitoring phases, appropriate documentation summarizing the performance of the facilities during the monitoring periods and the effects of these performances on predictions of future performance is to be submitted to the AECB. Approvals to abandon will only be given after review and acceptance of this information.

Appendix I (attached) summarizes the regulatory requirements, guidelines, or principles specified in the AECB Approvals under which the decommissioning plans for Beaverlodge, Madawaska, and Agnew Lake were developed and executed. These data are categorized as "generic" (ie., common to all three sites) or "site specific".

As noted in the preceding section, Table 1 (attached) summarizes existing, or curently proposed, AECB requirements, guidelines, principles or policies pertaining to the decommissioning of uranium mine and mill facilities.

The component activities of the decommissioning plans approved by the regulatory agencies for Beaverlodge, Madawaska, and Agnew Lake are presented in Table 2 (attached). Where appropriate, corresponding compliance or non-compliance with regulatory criteria or company predictions is indicated.

4. CONCLUSIONS AND OBSERVATIONS

During the decommissioning of the Beaverlodge Madawaska, and Agnew Lake facilities, identical goals relating to public health, safety, and protection of the environment were pursued. In order to provide reasonable assurance that these objectives would be met, appropriate regulatory requirements were imposed for all facilities. These consisted of both generically applicable, and site specific, conditions and criteria as outlined in Appendix I. The latter were necessitated by site specific concerns, and for the most part, reflected site characteristics, historical operations, proposed decommissioning activities, and company and regulatory agency priorities. A similar joint-regulatory process was adopted by the AECB for all facilities.

Subsquent to the recent completion, or near completion, of decommissioning activities at Beaverlodge, Madawaska, and Agnew Lake, the respective companies have embarked on monitoring programs to assess the post-decommissioning performance of the sites. While the results generated by these programs to date should be viewed as tentative, the following general conclusions/ observations appear valid for the three sites in the interim:

- The proposed decommissioning plans have been, or are being, implemented as approved;

- The generic conditions listed in Appendix I have been, or are being, complied with;

- Site specific requirements relating to reduction of gamma fields, decontamination of salvaged materials, and grading, contouring and rehabilitation of reclaimed areas have been, or are being, complied with;

- Low population doses appear probable as a consequence of the decommissioned sites;

- The annual quantities of radioactive and non-radioactive contaminants discharged to the environment after decommissioning will not exceed those allowed during the operational phase;

- The use of passive barriers to contain radioactive and non-radioactive contaminants within the decommissioned sites has been maximized;

- The concentrations of contaminants released from the decommissioned sites appear likely to comply with most relevant water quality criteria; and

- The AECB regulatory philosophy applied to the decommissioning of these sites is consistent with subsequent AECB regulatory initiatives pertaining to the decommissioning of nuclear facilities and, in particular, uranium mines and mills.

5. REFERENCES

(1) Agnew Lake Mines Limited, Close-out of Agnew Lake Mines - Summary and Appendices; 1982 July.

(2) Agnew Lake Mines Limited, Conceptual Close-out Plans For The Abandonment of the Agnew Lake Mines Property; 1980 December.

(3) Atomic Energy Control Board, Agnew Lake Mines Limited Decommissioning and Close-out Approval AECB-DCOA-132-0; 1983 February 2.

(4) Atomic Energy Control Board, Eldorado Nuclear Limited Beaverlodge and Dubyna Operations Decommissioning and Close-out Approval AECB-DCOA-130-0; 1982 September.

(5) Atomic Energy Control Board, Eldorado Resources Limited Decommissioning Approval AECB-DA-142-0; 1983 November.

(6) Atomic Energy Control Board, Madawaska Mines Limited Decommissioning Approval AECB-DA-139-0; 1983 November.

(7) Eldorado Nuclear Limited, Conceptual Reclamation Plan For Beaverlodge Fay/Verna Operations; 1981 June.

(8) Eldorado Resources Limited, Plan for the Close-out of the Beaverlodge Site; 1983 August.

(9) F. Clyde Lendrum Consulting Limited, Report to Madawaska Mines Ltd. Proposal for Decommissioning and Close-out of the Bancroft Property; 1983 June.

(10) Golder Associates Limited, Report to Eldorado Nuclear Limited, Subsurface Investigations, Minewater Lake, Meadow Lake and Ace Creek Discharge Area, Eldorado, Saskatchewan; 1982 June.

(11) Golder Associates Limited, Report to Eldorado Resources Limited, Potential Mine Water Seepage From the Fay/Verna Mine Complex at Beaverlodge; 1983 July.

(12) MacLaren Plansearch, Report to Eldorado Resources Limited, Hydrologic Investigations of the Tailings Management System, Beaverlodge, Saskatchewan; 1983 March.

(13) MacLaren Plansearch, Report to Eldorado Resources Limited, Operating History and Environmental Conditions; 1983 February.

(14) Phillip A. Lapp, Report of The National Technical Planning Group On Uranium Tailings Research To The Canada Centre For Mineral and Energy Technology, Energy, Mines and Resources Canada; 1981 September.

(15) Senes Consultants Limited, Report to Eldorado Resources Limited, Radiological and Environmental Assessments of Close-Out Options; 1983 April.

(16) SKR Limited, Report to Eldorado Resources Limited, Beaverlodge Tailings and Sludges - Close-Out Engineering Feasibility Studies; 1983 February.

(17) Tsivoglu and O'Connell, Robert A. Taft Sanitary Engineering Center, Cleveland, Ohio, Waste Guide for The Uranium Mining Industry, 1982.

A SUMMARY OF THE CONDITIONS AND REQUIREMENTS CONTAINED IN AECB APPROVALS GOVERNING THE DECOMMISSIONING OF THE BEAVERLODGE, MADAWASKA AND AGNEW LAKE OPERATIONS

A. Generic Conditions

The following conditions appear verbatim, or in slightly modified form, in all AECB Approvals relating to the decommissioning of the Beaverlodge, Madawaska, and Agnew Lake facilities:

1. "The Company shall ensure that maximum permissible doses of ionizing radiation or exposure to radon daughters set out in Schedule II of the Atomic Energy Control Regulations, are not exceeded, but notwithstanding the permissible doses and exposures in the Regulations, doses of ionizing radiation and exposure to radon daughters received by any person shall be kept as low as reasonably achievable, social and economic factors being taken into account;"

2. "The Code of Practice attached as Appendix ___ to this Approval shall be implemented and complied with by the Company. The Company shall ensure that when the radon daughter concentrations and gamma dose rates are determined to fall within the ranges set out in the Action Levels Column of the Code, the corresponding measures stipulated in the Protective Actions column are carried out within the time period stated or implied by the Code;"

3. "The Company shall ensure that every contractor employed within the facilities is made aware of and adheres to the relevant conditions of this approval. It is the Company's responsibility to outline its methods and procedures regarding matters concerning health and safety, and emergency and working procedures to the contractors;"

4. "Information revealing any degradation of components or systems potentially deleterious to man or the environment shall be reported promptly to the Board;"

5. "There shall be sufficient qualified personnel in attendance during all operations associated with decommissioning and reclamation to ensure that those activities are completed safely and in accordance with plans and procedures approved by the Board;"

6. "Subject to the terms and conditions of this Approval, all laws of general application from time to time in force in the Province of _____ are applicable to, and in respect of, the facility and must be complied with except to the extent such laws conflict with any federal statute or any order, rule or regulation made thereunder;"

7. "Any situation that results in, or is likely to result in, a hazard to the health and safety of any person shall be reported to the Board within twenty-four hours of its detection, and appropriate action shall be taken to eliminate or reduce the hazard and to mitigate any consequences;"

8. "Persons appointed as inspectors under section 12 of the Regulations shall at all reasonable time be given access to the facilities, and to all plans,

drawings, documents and records pertaining to the design, construction, testing, past operations, monitoring and decommissioning of the facility;"

9. "Attempted or actual breaches of security, threats, and attempts or actual acts of sabotage must be reported to the Board within twenty-four hours of the occurrence being detected;"

10. "The Company shall record all working environment monitoring results and post these results. If for some reason the results are erroneous, they are still to be recorded and posted and are to be marked with an explanatory note;"

11. "Tests, analyses, inventories, inspections and reports deemed necessary and requested by the Board are to be carried out or submitted as stipulated by the Board;"

12. "Records required to be maintained by licensees under Subsection II (1)(c) of the Atomic Energy Control Regulations shall be maintained and must be issued at least quarterly to each employee as those records pertain to that employee and submitted quarterly to the Board no later than one month after the quarter being reported;"

13. "All shafts, raises, adits and other openings to the surface shall be sealed to prevent inadvertent or unauthorized entry in accordance with the following:

(a) all shaft and raise openings shall be (i) backfilled with inert material in such a manner that any subsidence of the material would not create a hazard to the safety of any person, or,
(ii) capped with reinforced concrete secured to solid rock.

(b) all accessible shafts shall be sealed with concrete bulkheads or filled with inert materials;"

14. "The Company shall preserve and submit to (the appropriate provincial agency) the following information pertaining to the operations:

(a) a complete set of mining plans and sections, showing with engineering detail, all excavations;

(b) survey and geological records, and

(c) (other site specific information required by the Province)."

15. "During the term of this Approval, annual reports describing all decommissioning, reclamation and monitoring activities conducted at the facilities over the calendar year shall be submitteed to the Board by _____ of each year;

16. "Contaminated scrap, or chemicals, resulting from decommissioning or reclamation of the facility must be disposed of in a manner approved by the Board;"

17. "Mine waste, tailings, sludges or other contaminated materials shall not be removed from the facilities without the prior written approval of the Board;" and

18. "All articles to be removed from the facility shall be monitored to determine whether they are radioactively contaminated. Prior to their removal, contaminated articles shall be cleaned to remove loose radioactive contamination. Special effort must be made to remove contamination from areas of difficult access, or from areas not effectively monitored by radiation detection instruments. Decontamination shall be undertaken such that residual surface contamination by emitting radionuclides does not exceed _____ kilobecquerels/square metre. Articles not meeting this level of decontamination shall be dealt with according to methods approved in writing by the Board;"

B. Site Specific Conditions

1. Beaverlodge

Site specific licence conditions were included in AECB-DCOA-130-0 and AECB-DA-142-0 as indicated below.

1.1 AECB-DCOA-130-0:

(a) "Decommissioning, reclamation, and close-out operations shall be executed in a manner approved by the Board within the time frames given in Figure 1 of the Eldorado Nuclear Limited submission titled, 'Progress Report #1 on the Decommissioning of the Beaverlodge Operations and Reclamation of the Site';"

(b) "Eldorado Nuclear Limited shall continue to operate the Marie Lake Treatment System until such time as it is demonstrated to the satisfaction of the Board that effluent treatment is no longer required;"

(c) "Eldorado Nuclear Limited shall conduct the decommissioning and reclamation of waste management associated aspects of the facility in compliance with the close-out requirements specified in Appendix 'B' attached;"

(d) "The Fay/Verna Mine and the mill shall be decommissioned and closed-out by the methods and procedures described in the Eldorado Nuclear Limited report titled 'Radiation Protection and Ventilation Requirements During the Salvage and Decommissioning Phases of the Beaverlodge Operation'," and the letter with attachments dated June 18, 1982 under the signature of Mr. R. Phillips, Environment Superintendent, Eldorado Nuclear Limited to Mr. Jacques Viljoen of the Aomic Energy Control Board;"

(e) "The Dubyna underground mine shall be decommissioned and closed-out by the methods and procedures described in the following correspondence: (i) the letter with attachments, dated 16 August, 1982 re' 'Dubyna Decommissioning' under the signature of A. W. Ashbrook; (ii) the letter with attachments, dated August, 1982 re' Closure of Surface Openings' under the signature of M.P. Filion;"

(f) "The quantity and concentration of radioactive or hazardous materials discharged from the facility are to be monitored and reported according to a program approved by the Board. Monitoring requirements will be adjusted periodically to reflect the changing status of the facility as close-out progresses;"

(g) "During the decommissioning phase, the levels of substances in effluents discharged from the facility may be up to but not greater than the limits specified in Appendix 'C' attached. The limits shall apply at the final point of control;"

(h) "Changes to the design, operation, or use of the waste management system require the approval of the Board;"

(i) "The use of the Fookes Lake tailings facility as a repository for wastes other than mill tailings requires the approval of the Board;"

(j) "On or before June 30, 1983 Eldorado Nuclear shall inform the Board in writing as to the decommissioning and reclamation options they propose to implement, the rationale for selection of options, the major activities involved, and the schedule(s) of implementation. Implementation of the preferred options shall be contingent on receipt of Board approval;"

(k) a condition identical to that given as A.18 of this Appendix, with the exception that a limit of 3.7 kilobecquerels/square metre of alpha activity was specified; and

(l) "The surfaces of waste rock dump and backfilled pits are to be graded or contoured."

1.2 AECB-DA-142-0

(a) "The facilities are to be decommissioned according to the methods and procedures and for the purposes described in the reference documents listed in Appendix 'B' to this Approval;"

(b) "The effectiveness of the decommissioning activities conducted at the facilities shall be monitored and reported in accordance with a program approved in writing by the Board;"

(c) "The surfaces or slopes of waste rock dump or backfilled pits shall be graded or contoured in a manner approved by the Board;"

(d) "Gamma surveys of the facilities shall be conducted in accordance with reference documents (e) and (g) of Appendix 'B' to this Approval;"

(e) as in 1.1 (b) preceding;

(f) as in 1.1 (i) preceding; and

(g) as in 1.1 (k) preceding;

2. Madawaska

Madawaska Mines Limited Decommissioning Approval AECB-DA-139-0 contained the following site specific conditions:

(a) "Subject to any other condition of this Approval, decommissioning of the facility shall be carried out in accordance with the Company's submission to the Board of June, 1983 entitled 'Proposal for Decommissioning and Close-Out of the Bancroft Property'. Any change to this proposal requires the prior written approval of the Board;"

(b) "The diversion and handling of runoff water from tailings area #1 and the decontamination of the mill shall be in accordance with detailed designs approved in writing by the Board;"

(c) "The environmental monitoring program outlined in Appendix 'B' shall be implemented. The levels of substances in the receiving waters shall not exceed the limits specified. Parameters and monitoring frequencies will be reviewed annually by the Board and the Company shall implement any changes requested;"

(d) "Waste rock and granular cover material must be placed over tailings area #1;"

(e) "Tailings area #2 shall be covered with material in accordance with the written instructions of the Board;"

(f) "Upon completion of the fourth year of the monitoring phase, the Company shall prepare a detailed report on the decommissioning of the facility. The matters to be addressed in the report shall require prior approval by the Board. This report shall be submitted to the Board, Environment Canada, Labour Canada, and the Ontario Ministries of Environment, Natural Resources and Labour at least three months before the end of the fifth year of the monitoring phase;" and

(g) a condition identical to that given as A.18 of this Appendix, with the exception that the specified limit was 100 kilobecquerels/square meter of beta activity;

3. Agnew Lake Mines

The Agnew Lake Mines Decommissioning and Close-Out Approval AECB-DCOA-132-0 contained the following site specific conditions:

(a) "Close-out of the site shall be executed in accordance with the Company's submission to the Board of December 23, 1980 entitled 'Conceptual Close-Out Plans For The Abandonment of the Agnew Lake Mines Property' and the details provided in the Company's submission of July 2, 1982 (F. Clyde Lendrum, consultant to the Company, to Robert S. Boulden and Bernie Zgola of the Board), subject to any specific conditions outlined here. Any changes to these plans will require the prior written approval of the Board;"

(b) "On or before June 30, 1983 the Company shall update and submit to the Board its proposed schedule for close-out of the facility (mine, mill, waste management). Details of the planned disposition of the mining and milling plant shall be included;"

(c) "By March 31, 1983 the Company shall submit for the approval of the Board an engineered design for the containment structure planned for the east end of the area to contain sludges and leach pile materials;"

(d) "By March 31, 1983 the Company shall design and submit to the Board an environmental monitoring program to address a five-year period which shall be implemented after completion of the decommissioning of the leach pile. This program shall address the objectives as outlined in Appendix 'A' and the submission should include a description of the parameters to be monitored and the frequencies of monitoring. The levels of substances at specified points in the receiving waters may be up to but not greater than the limits specified in Appendix 'B' attached. The specified points are designated AL-13 (Ministic Creek) and AL-16 (John Creek) with reference to the Company's existing environmental monitoring program. If during the period of this Approval the environmental monitoring program indicates lack of compliance with the standards and/or criteria set out in the Approval, the Company will undertake remedial work as required by the Board. Annual reports shall include an analysis of each year's environmental monitoring results and a detailed assessment addressing the long term behaviour of the facility will be required before the end of the five-year period;" and

(e) A condition identical to that given as A.18 of this Appendix, with the exception that the specified limit was 37 kilobecquerels/square metre of beta activity;

C. Appendices

Several of the appendices referenced in the "site specific" conditions of section B preceding contain additional information relating to specified requirements, performance criteria and monitoring programs applicable during the decommissioning and post-decommissioning phases. These appendices are; Appendix 'B' of AECB-DCOA-130-0, Appendices 'B' and 'D'[1] of AECB-DA-142-0, Appendix 'B' of AECB-DA-139-0, and Appendices 'A' and 'B' of AECB-DCOA-132-0. Reproductions of their contents follow.

AECB-DCOA-130, Appendix 'B'

CLOSE-OUT REQUIREMENTS - ELDORADO NUCLEAR LIMITED

The following requirements, objectives and criteria have been developed by the regulatory agencies for application to the decommissioning, reclamation and close-out of the Beaverlodge operations.

[1] Identical to Appendix 'C' of AECB-DCOA-130-0 which is not reproduced.

A. RADIATION PROTECTION PRINCIPLES

The following radiation protection principles shall apply to the close-out of Beaverlodge:

1. The dose limits specified in the Atomic Energy Control Regulations shall be observed.

2. Any exposures arising from the site should be kept as low as reasonably achievable, economic and social factors being taken into account.

B. ENVIRONMENTAL QUALITY REQUIREMENTS/OBJECTIVES

1. The annual quantities of radioactive and non-radioactive contaminants released to the environment after close-out of the site should not exceed the corresponding releases during the operational phase. Operational releases will be based on the assumption that good operational practices were in use and will be based on each unit operation.

2. In addition to the requirement expressed in B.1 above, the Saskatchewan water quality guidelines shall apply as close-out objectives for specified parameters at sampling points AC-14 (Ace Creek at Beaverlodge Lake), TL-7 (Meadow Lake outfall), DB-6 (Dubyna Lake discharge) and an appropriate location (to be determined) on the Pistol Lake system. The specified parameters shall be pH, TSS, Fe, Cu, Zn, As, and Ra (total); and the corresponding objective concentrations shall be those values listed in "Table 1 - Surface Water Quality Objectives" of the Environment Saskatchewan publication titled "Water Quality Objectives (February 1977 Edition)". Further, concentration objectives for Uranium and TDS of .25 milligrams per litre and 250 milligrams per litre respectively shall also apply at the above sampling points. All concentrations shall apply as annual average concentrations with the frequency of sampling being as required or approved by the regulatory agencies.

3. Releases of liquid contaminants (radioactive and non-radioactive) from sources outside of the systems referred to in 2. preceding (e.g. other satellite mining operations, waste rock piles) shall be dealt with on a case-by-case basis as the need arises. Future considerations may include impact of releases, requirements for mitigative measures, application of water quality criteria (mixing zones, monitoring locations), etc. The course of action in each instance will be dependent on the outcome of Company-Agency discussions.

4. Dust emissions from the closed-out site should be minimized in a manner consistent with good engineering practice.

C. ENGINEERING PRINCIPLES/REQUIREMENTS

1. The use of passive barriers, natural or engineered, to control radioactive and non-radioactive releases from the closed-out site should be maximized.

2. The use of containment systems which may be subject to abrupt degradation of performance should be minimized and preference given to systems which only degrade gradually.

3. All containment systems must be evaluated in terms of their long-term performance durability. Reliance on maintenance should be minimized.

D. OTHER REQUIREMENTS

In addition to the requirements/objectives of Sections A, B, and C preceding, the following requirements/objectives shall also apply to the closed-out Beaverlodge operations:

1. Attenuation of Gamma Fields

(a) Gamma Fields over waste rock areas, tailings deposits, sludges, roadways, and the mine/mill site should comply with the following:

(i) a requirement that the gamma fields measured at 1 meter above surface not exceed 6.45×10^{-8} coulombs/ kilogram/hour (250 microroentgens/hour),

(ii) an objective that the gamma fields measured at 1 meter above surface be reduced to less than 6.45×10^{-8} coulombs/kilogram/ hour in accordance with the ALARA principle.

(b) Gamma surveys (pre-remedial and post-remedial) shall be conducted over the relevant areas. A survey grid approved by the regulatory agencies shall be followed, and only appropriate calibrated survey instrumentation employed.

2. Attenuation of Radon

(a) The question of radon reduction at source should be addressed.

(b) Any selective placement of gamma attenuation cover over an area should be done in such a manner so as to coincidentally optimise radon reduction over the area.

3. Decontamination/Disposal of Salvageable Equipment

(a) Only approved procedures shall be followed in the decontamination and/or disposal of salvageable equipment from the Beaverlodge site.

(b) Radioactively contaminated materials salvaged from the facility shall be cleaned by an approved method to remove loose radioactive contamination. Salvage intended for distribution into the public domain shall be decontaminated as required to ensure that residual surface contamination by alpha-emitting radionuclides does not exceed 3.7 kilobecquerels/square meter (10^{-5} microcuries/square centimeter) of area.

4. Cleanup of Tailings Spills

As a general principle, tailings spills should be excavated and the material removed to the main tailings facility (or managed in another manner acceptable to the Board).

5. Surface Stabilization

All reclaimed areas must be stabilized against erosion.

6. Monitoring Requirements

Monitoring requirements (other than those specified in the preceding sections) will be addressed as the need arises by subsequent discussions amongst the Company and Agencies.

AECB-DA-142-0, Appendix 'B':

REFERENCE DOCUMENTS AS PER CONDITION 1 OF AECB-DA-142-0

(a) The Eldorado Nuclear Ltd. report titled "Radiation Protection and Ventilation Requirements During the Salvage and Decommissioning Phases of the Beaverlodge Operation".

(b) The letter with attachments, dated June 8, 1982, from R. Phillips of Eldorado Nuclear Ltd. to J. Viljoen of the Board re: "Radiation Protection and Ventilation Requirements - Decommissioning Phases."

(c) The letter with attachments, dated 16 August 1982, from A. Ashbrook of Eldorado Nuclear Limited to J. Viljoen of the Board, re: "Dubyna Decommissioning".

(d) The letter with attachments, dated 19 August 1982, from M. Filion of Eldorado Nuclear Limited to J. Viljoen of the Board, re: "Closure of Surface Openings".

(e) The Eldorado Nuclear Limited submission dated 82.10.07, titled "Proposed Gamma Radiation Surveys - Waste Rock, Tailings and Roadways", and submitted under the covering letter, dated 13 October 1982, from M. Filion of Eldorado Nuclear Limited to W. Whitehead of the Board.

(f) The letter, dated November 9, 1982, from W. Whitehead of the Board to M. Filion of Eldorado Nuclear Ltd. transmitting the regulatory agencies review comments on the Eldorado Nuclear Limited submission titled "Proposed Gamma Radiation Surveys - Waste Rock, Tailings and Roadways".

(g) The Eldorado Resources Limited report titled "Plan for the Close-out of the Beaverlodge Site", dated August 1983, submitted to the Board August 15, 1983 and supported by the following reports and documentation:

(i) "1. Decommissioning of the Beaverlodge Mine/Mill Operations and Reclamation of the Site - June, 1982"

(ii) "2. Decommissioning of the Beaverlodge Mine/Mill Operations and Reclamation of the Site - Operating History and Environmental Conditions" - Feruary, 1983"

(iii) "2B. Decommissioning of the Beaverlodge Mine/Mill Operations and Reclamation of the Site - Hydrologic Investigations - April, 1983"

(iv) "3. Decommissioning of the Beaverlodge Mine/Mill Operations and Reclamation of the Site - Beaverlodge Tailings and Sludges Close-out Engineering Feasibility Studies - February, 1983"

(v) "4. Decommissioning of the Beaverlodge Mine/Mill Operations and Reclamation of the Site - Radiological and Environmental Assessment of Close-out Options - April, 1983"

(vi) "Potential Mine Water Seepage From The Fay/Verna Complex at Beaverlodge - July, 1983"

(vii) the letter with attachments, dated 6 June, 1983 from R. Knapp of Senes Consultants Limited to A. Ashbrook of Eldorado Resources Limited re: "Decommissioning of the Beaverlodge Mine/Mill Operation and Reclamation of the Site, Environmental and Radiological Pathways Analysis - Supplementary Discussion on Water Quality - Effects of Removing Tailings from Land and Lakes"

(viii) the letter with attachments dated 6 June, 1983 from D. Chambers of Senes Consultants Limited to A. Ashbrook of Eldorado Resources Limited re: "Decommissioning of the Beaverlodge Mine/Mill Operation and the Reclamation of the Site, Environmental and Radiological Pathways Analysis - Supplementary Discussion of Certain Factors which Potentially Affect the ALARA Analysis"

(ix) the letter with attachments, dated 8 August, 1983 from R. Knapp of Senes Consultants Limited to M. Filion of Eldorado Resources Limited re: "Comments on Report No. 4 - Radiological and Environmental Assessment of Close-out Options - from AECB letter of July 28, 1983".

AECB-DA-142-0, Appendix 'D'

Substance	*Arithmetic Mean Concentration	**Composite Sample Concentration	Grab Sample Concentration
Arsenic mg/L	0.5	0.75	1.0
Copper mg/L	0.3	0.45	0.6
Lead mg/L	0.2	0.3	0.4
Nickel mg/L	0.5	0.75	1.0
Zinc mg/L	0.5	0.75	1.0
Total Suspended Matter mg/L	25	37.5	50
Radium 226 Bq/L (Dissolved) pCi/L	0.37 (10)	0.74 (20)	1.11 (30)

pH: the pH level of the sample must be equal to or greater than 6 in 75% of the samples collected according to an agreed upon program, and the pH level of single samples must not be less than 5.

* "Arithmetic mean" means the average value of the concentrations in composite or grab samples collected over a time period specified by the Board pursuant to conditions 14. and 15. of this Approval.

** "Composite sample" means:

(a) a quantity of undiluted effluent consisting of a minimum of three equal volumes of effluent or three volumes proportionate to flow that have been collected at approximately equal time intervals over a sampling period of not less than 7 hours and not more than 24 hours, or

(b) a quantity of undiluted effluent collected continually at an equal rate or at a rate proportionate to flow over a sampling period of not less than 7 hours and not more than 24 hours.

Note: For purposes of this Approval, the above limits shall apply at the sampling location designated during operations as "TL-7" and more particularly described in the Eldorado Resources Limited report titled "2. Decommissioning of the Beaverlodge Mine/Mill Operations and Reclamation of the Site - Operating History and Environmental Conditions"

AECB-DA-139-0, Appendix 'B'

WATER QUALITY MONITORING PROGRAM

Water quality objectives shall be applied for specified parameters at sampling points in Bow Lake (M1; end of S. Pataran's dock) and Bentley Lake (M2; adjacent to grout curtain beside east dam). The specified parameters and corresponding objectives shall be:

Ammonia (NH_3 as N)	.02mg/L (un-ionized)
Radium 226	1 Bq/L (total) or 27 pCi/L (total)

Monitoring of these two stations shall be on a quarterly basis and shall also include the following parameters to aid in assessing the overall performance of the decommissioned site:

pH	Uranium (total)
Iron	Total Dissolved Solids
Conductivity	

In addition, the following sampling points shall be monitored for all of the above parameters at the frequencies indicated. Water levels shall be recorded in all test wells at the time of sampling.

POINTS	FREQUENCIES
West Side Test Wells (1,2,5,6,7)	Quarterly
East Side Test Wells (1,2) and Pz 3	Quarterly
Sand Filter Tile Drain (TW8)	Quarterly (monthly if flow entering filter bed).
Flow (entering filter bed)	Monthly (when active)
West Dyke Seepage	Quarterly

Results of this monitoring program shall be submitted to the Board when available and annual summaries shall be included in the annual reports due March 31 of each year of the Approval.

AECB-DCOA-132-0, Appendix 'A'

Objectives of Environmental Monitoring Program

1. To monitor the integrity of dams, embankments, decant facilities, surface runoff channels and contouring of the sludge/leach pile materials; the program should assess movement of the phreatic surface in dams, monitor vertical and horizontal displacement of dam structures and sludge/leach pile materials, and document vegetative cover and the physical performance of the facility (e.g. photographs).

2. To monitor hydrological and chemical changes occurring within the sludge/leach pile area; the network installed should be capable of identifying variations within the blended material and where necessary within the drift material and bedrock underlying this blended material; solid samples should be extracted for physical and chemical analyses; vegetation and surface soil supporting this vegetation should also be monitored to help predict the permanence of vegetative cover.

3. To monitor surface water upstream and downstream of the sludge/leach pile area and the abandoned mine/mill complex and groundwater downstream of these areas.

4. To monitor the quantity and quality of water filling the mine shaft to enable predictions of future discharges from the shaft to the surface.

5. To verify the radioactivity pathways analysis submitted as part of the close-out plan; a once-only survey of radiation levels in air and water to include a survey of gamma fields will be required, to be carried out near the end of the five year monitoring period.

AECB-DCOA-132-0, Appendix 'B'

Water quality objectives shall be applied for specified parameters at sampling points designated AL-13 (Ministic Creek) and AL-16 (John Creek). The specified parameters and corresponding objectives shall be:

Ammonia	.02 mg/L (un-ionized)
Radium 226	1 Bq/L (total)

As well, other parameters shall be monitored to aid in assessing the overall performance of the decommissioned site. These include:

Acidity	Uranium
pH	Total Dissolved Solids Total Phosphorus
Suspended Solids	
Calcium	Thorium 232
Iron	Sulphate

TABLE 1

RECENT AECB REGULATORY INITIATIVES OF RELEVANCE

TO THE DECOMMISSIONING OF URANIUM MINES

DOCUMENT TITLE	DOCUMENT DESCRIPTION/STATUS	RELEVANCE OF DOCUMENT TO THE DECOMMISSIONING OF URANIUM MINES AND MILLS
"Guidelines for the Preparation of Decommissioning Plans for Uranium Mine Waste Management"	"Draft"; distributed for comment: July, 1983	•Intended to provide direction to companies preparing their decommissioning plans, and to provide regulatory agencies with guidelines and criteria for evaluating those plans and activities. •Enunciates the following requirements and principles: (i) The dose limits specified in the Atomic Energy Control Regulations shall apply; (ii) The collective dose arising from radioactive waste management practices shall be kept as low as reasonably achievable, economic and social factors being taken into account; (iii) Access to tailings or other contaminated waste should be minimized. The disposal objective should be kept in mind at all times; (iv) The use of passive barriers, natural or engineered, to contain radioactive and non-radioactive contaminants within a decommissioned site should be maximized; (v) Where containment system may degrade continuously with time, preference should be given to systems which degrade gradually; (vi) There should be no need for frequent maintenance of containment systems; (vii) The annual quantities of radioactive and non-radioactive contaminants discharged to the environment after decommissioning and abandonment should not exceed those allowed during the operational phase; (viii) Where contaminants are released from a decommissioned site, the concentrations at designated points in the environment should comply with applicable federal and provincial water quality objectives; (ix) Reliance on institutional controls as a means of adhering to these guidelines after abandonment should be minimized;

TABLE 1 (CONTINUED)

RECENT AECB REGULATORY INITIATIVES OF RELEVANCE

TO THE DECOMMISSIONING OF URANIUM MINES

DOCUMENT TITLE	DOCUMENT DESCRIPTION/STATUS	RELEVANCE OF DOCUMENT TO THE DECOMMISSIONING OF URANIUM MINES AND MILLS
		(x) A conceptual decommissioning plan for each licensed facility should be submitted to the AECB not later than 18 months after the issuance of these guidelines. The plan should include technical and financial information including an assessment of the capital, operating and monitoring costs of the proposed plan; (xi) In support of a conceptual decommissioning plan, a detailed report describing and quantifying the various radiation exposure and other environmental pathways (operational, transitional and long-term) should be submitted to the AECB not later than 18 months after the issuance of these guidelines; (xii) An update of a decommissioning plan and a pathways study will be required whenever a significant change is proposed to the waste management facility. These updates will be required prior to AECB granting approval for said changes; and (xiii) For all new facilities, a preliminary decommissioning plan and pathways study will have to be submitted and approved prior to the issuance of a Mine Facility Operating Licence (MFOL).
"A Guide to the Licensing of Uranium and Thorium Mine and Mill Waste Management Systems"	Consultative Document C-36-Proposed Regulatory Guide; Issued for comment: June 2, 1986	°Document intended as a guide to licensees or potential licensees; °Includes various references to general decommissioning principles, requirements, guidelines, and objectives. In particular, section "2.6 Decommissioning" refers to licensing prohibitions and requirements, preparation of decommissioning proposals, radiation protection principles, reliance on institutional controls, and releases of contaminants to the environment; °Consistent with the 1983 "Guidelines" and "C-59" but also contains specific references to the decommissioning of facility components.

TABLE 1 (CONTINUED)

RECENT AECB REGULATORY INITIATIVES OF RELEVANCE

TO THE DECOMMISSIONING OF URANIUM MINES

DOCUMENT TITLE	DOCUMENT DESCRIPTION/STATUS	RELEVANCE OF DOCUMENT TO THE DECOMMISSIONING OF URANIUM MINES AND MILLS
"Regulations Respecting Uranium Mining"	Consultative Document C-59- Proposed Regulations; Issued for comment: January 4, 1984	°Consolidates, in the context of specific uranium regulations, AECB requirements applicable to uranium mining facilities, including general obligations of licencees to propose, implement and monitor decommissioning activities to provide for public health and safety and protection of the environment. Most of these requirements are described in "Part X Suspension and Cessation of Operations, Decommissioning and Abandonment of Uranium Mining Facilities"; °Consistent with 1983 "Guidelines" and "C-36".
"Proposed General Amendments to the Atomic Energy Control Regulations"	Consultative Document C-83- Proposed Amendments to Regulations; Issued for comment: April 28, 1986	°Proposes the inclusion in the Regulations of explicit references to the decommissioning of nuclear facilities (including uranium mines and mills). In addition to minor modifications of existing wording, insertion of a section titled "Decommissioning Licence" is intended.
"The Basis for Exempting The Disposal of Certain Radioactive Materials From Licensing"	Consultative Document C-85- Proposed Regulatory Policy Statement; Issued for comment: May 6, 1985	°Of indirect relevance to the decommissioning of uranium mines and mills, may provide some guidance during associated pathways analyses, vis à vis dose calculation methodology (acceptable "cut-off" limits, interpretation of significance of results).
"Policy on the Decommissioning of Nuclear Facilities"	Consultative Document C-90- Proposed Regulatory Policy Statement; Issued for comment: October 15, 1985	°Addresses the decommissioning of nuclear facilities in general; °Consistent with the other AECB regulatory initiatives relating to the decommissioning of uranium mines and mills, recognizes the importance of site specific factors, protection of public health and safety and the environment, post-decommissioning monitoring, and minimization of active institutional controls over the long term;

TABLE 1 (CONTINUED)

RECENT AECB REGULATORY INITIATIVES OF RELEVANCE

TO THE DECOMMISSIONING OF URANIUM MINES

DOCUMENT TITLE	DOCUMENT DESCRIPTION/STATUS	RELEVANCE OF DOCUMENT TO THE DECOMMISSIONING OF URANIUM MINES AND MILLS
"Policy Statement on Maximum Acceptable Levels of Contamination on Equipment and Materials Leaving Uranium Mine Facilities"	Consultative Document C-95- Proposed Regulatory Policy Statement; Issued for comment: March 19, 1986	*Describes the general information required by the AECB in support of an application for a licence to decommission a nuclear facility. *Specifies surface contamination limits applicable to disposal/salvage of radioactive materials during decommissioning operations.

TABLE 2

DECOMMISSIONING OF CANADIAN URANIUM MINES AND MILLS

COMPONENT ACTIVITIES AND ASSOCIATED REQUIREMENTS

FACILITY	COMPONENT DECOMMISSIONING/ RECLAMATION ACTIVITIES	ASSOCIATED REQUIREMENTS/ CRITERIA	CURRENT STATUS/RESULTS
BEAVERLODGE	(i) Salvage of equipment and materials, decontamination as required;	(i) As per condition 8.1.1 (1) of Appendix I;	(i) Completed, compliance confirmed by AECB survey;
	(ii) Closure of mine shafts, adits and ventilation raises;	(ii) As per condition A.13 of Appendix I;	(ii) Completed, compliance confirmed by AECB inspections;
	(iii) Gamma survey/reclamation of site roadways;	(iii) Gamma levels, measured at one meter above surface, not to exceed 6.45 x 10^{-8} coulombs/kilogram/hour (250 micro-Roentgens/hour);	(iii) Completed, gamma fields less than criterion and generally determined to be near that of construction materials and natural background;
	(iv) Reclamation of mine/mill site (demolition of mine buildings, partial demolition of mill and subsequent burial with waste rock, grading and contouring of site and waste rock piles);	(iv) Gamma levels, measured at one meter above surface, not to exceed 6.45 x 10^{-8} coulombs/kilogram/hour (250 micro-Roentgens/hour), grading and contouring as appropriate;	(iv) Completed, compliance confirmed by AECB inspection and survey;
	(v) Surface reclamation of "satellite" mine sites (demolition of structures, gamma survey and remedial work as indicated, grading and contouring as appropriate) - Hab, Verna, Dubyna, Eagle, Intermediate, Ace, 72-Zone, and Bolger mining areas;	(v) Gamma levels, measured at one meter above surface, not to exceed 6.45 x 10^{-8} coulombs/kilogram/hour (250 micro-Roentgens/hour), grading and contouring as appropriate; predicted water quality at sampling points DB-6 and AN-5 to be realized;	(v) Completed satisfactorily, compliance gamma surveys and inspections conducted by AECB, water quality monitoring on-going;

TABLE 2 (CONTINUED)

DECOMMISSIONING OF CANADIAN URANIUM MINES AND MILLS

COMPONENT ACTIVITIES AND ASSOCIATED REQUIREMENTS

FACILITY	COMPONENT DECOMMISSIONING/ RECLAMATION ACTIVITIES	ASSOCIATED REQUIREMENTS/ CRITERIA	CURRENT STATUS/RESULTS
BEAVERLODGE	(vi) Reclamation of Mine Water Lake (removal of tailings and sludges, restoration of natural water levels);		(vi) Excavation and removal of tailings completed satisfactorily, Minewater Lake restored to natural elevation by breaching of saddle dam, natural vegetation recovering rapidly;
	(vii) Reclamation of the Fookes Lake tailings facility (placement of .6 m waste rock cover over exposed tailings, replacement of wooden water level control structure by construction of a rock-till berm);	(vii) Stabilization of exposed tailings surface, gamma fields measured at one meter above surface not to exceed 6.45 x 10^{-8} coulombs/kilogram/hour (250 micro-Roentgens per hour);	(vii) Cover placement completed, gamma fields reduced to below criterion, berm constructed across outlet channel, post-decommissioning outflows very low;
	(viii) Reclamation of the Marie Lake tailings/effluent treatment system (removal of tails from the inlet and outlet channels and various locations along the shoreline; placement of .6 m of rock cover over exposed tailings delta, removal/demolition of effluent treatment system);	(viii) Stabilization of exposed tailings, gamma fields measured at one meter above surface not to exceed 6.45 x 10^{-8} coulombs/kilogram/hour (250 micro-Roentgens per hour);	(viii) Cover placement completed, gamma fields reduced to below criterion, effluent treatment discontinued, post-decommissioning outflows very low;
	(ix) Reclamation of the Meadow Lake precipitation pond (removal of barium-radium precipitate and disposal underground, restoration of original water level by removal of stop logs from outlet control structure);	(ix) Environmental loadings during the post-decommissioning phase to be less than during operations; predicted water quality at outlet control (TL-7) to be realized;	(ix) Removal and disposal underground of sludges completed, natural vegetation recovering will stream flow past TL-7 appears greatly reduced since shutdown and completion of decommissioning works, transition phase water quality monitoring underway at TL-7;

TABLE 2 (CONTINUED)

DECOMMISSIONING OF CANADIAN URANIUM MINES AND MILLS

COMPONENT ACTIVITIES AND ASSOCIATED REQUIREMENTS

FACILITY	COMPONENT DECOMMISSIONING/ RECLAMATION ACTIVITIES	ASSOCIATED REQUIREMENTS/ CRITERIA	CURRENT STATUS/RESULTS
BEAVERLODGE	(x) Reclamation of tailings line spills (removal, cover with .6 m of rock, or leave "as-is" as per agreement between Company and the regulatory agencies);	(x) Non-vegetated and accessible tailings to be covered or removed, inaccessible tailings or vegetated, well contained, tailings to be left "as is"; gamma fields over covered tailings to be coincidentally reduced to 645 x 10^{-8} coulombs/kilogram/hour (250 micro-Roentgens/hour);	(x) Completed in compliance with agreement;
	(xi) Reclamation of Ace Creek and floodplain (removal of tailings);	(xi) Predicted water quality at outlet of Ace Creek (AC-14) to be realized;	(xi) Water quality monitoring on-going, residual gamma fields than 6.45 x 10^{-8} coulombs/ kilogram/hour (250 micro-Roentgens per hour);
	(xii) Demolition of the townsite of Eldorado, Saskatchewan.		(xii) Completed July, 1985.
MADAWASKA MINES LTD.	(i) Salvage of equipment and materials, associated decontamination as required;	(i) As per Condition B.2(g) of Appendix I;	(i) Completed;
	(ii) Closure of mine shafts, adits and ventilation raises;	(ii) As per Condition A.13 of Appendix I;	(ii) Partially completed

TABLE 2 (CONTINUED)

DECOMMISSIONING OF CANADIAN URANIUM MINES AND MILLS

COMPONENT ACTIVITIES AND ASSOCIATED REQUIREMENTS

FACILITY	COMPONENT DECOMMISSIONING/ RECLAMATION ACTIVITIES	ASSOCIATED REQUIREMENTS/ CRITERIA	CURRENT STATUS/RESULTS
MADAWASKA MINES LTD.	(iii) Reclamation of Tailings Area No. 1 (placement of .3 to .5 meter waste rock cover, construction of rip-rapped runoff diversion channel along north edge of tailings, rerouting of seepage from west sump to septic tile bed, vegetation of east berm to be completed);	(iii) Stabilization of surface of tailings, water quality limits at sampling points M1 and M2, gamma survey of facility to be completed near end of monitoring phase;	(iii) Cover placement construction of runoff seepage diversion channel completed, water quality monitoring on-going;
	(iv) Reclamation of Tailings Area No. 2 (completion of cover placement over exposed tailings and surface contouring);	(iv) gamma survey to be completed near end of monitoring phase;	(iv) Cover placement and contouring completed;
	(v) Reclamation of barium-radium and sulphate settling tank (contents to be disposed of in dry section of tailings and tank backfilled);		(v) Completed;
	(vi) Demolition of buildings.		(vi) Work proceeding.
AGNEW LAKE MINES LTD.	(i) Salvage of equipment and materials, decontamination as required;	(i) As per condition B.3(e) of Appendix I;	(i) Completed;
	(ii) Closure of mine shafts, adits, and ventilation raises;	(ii) As per condition A.13 of Appendix I;	(ii) Completed;

TABLE 2 (CONTINUED)

DECOMMISSIONING OF CANADIAN URANIUM MINES AND MILLS

COMPONENT ACTIVITIES AND ASSOCIATED REQUIREMENTS

FACILITY	COMPONENT DECOMMISSIONING/ RECLAMATION ACTIVITIES	ASSOCIATED REQUIREMENTS/ CRITERIA	CURRENT STATUS/RESULTS
AGNEW LAKE MINES LTD.	(iii) Transfer of leach pile and underlying sand blanket to tailings area, contouring and seeding of site;		(iii) Completed;
	(iv) Reclamation of tailings area (addition of leach pile materials, placement of cover material over tailings and vegetation of same, reinforcement of west dam, breaching of middle and east dams);	(iv) Stabilization of tailings surface, gamma survey to be completed near end of monitoring phase, water quality limits at sampling points on Ministic Creek (AL-13) and John Creek (AL-16).	(iv) Completed, water quality monitoring on-going at sampling points AL-13 and AL-16;
	(v) Demolition of buildings/structures;		(v) Completed;
	(vi) Contouring of pregnant and barren ponds; and		(vi) Completed;
	(vii) Covering and re-vegetation of industrial landfill.		(vii) Completed, re-vegetation progressing well.